Whence $dX=k^2[(y^2-x^2)dx-2xydy]\div(x^2+y^2)^2$ and $dY=k^2[(x^2-y^2)dy-2xydx]\div(x^2+y^2)^2$.

Hence $\dfrac{dX}{dY}=\dfrac{(x^2-y^2)dy-2xydx}{(y^2-x^2)dx-2xydy}$.

Hence, if x' and y' be the co-ordinates of a point on the curve, the tangent at its inverse point may be

written $\left(y-\dfrac{k^2y'}{x'^2+y'^2}\right)=\dfrac{(x'^2-y'^2)dy'-2x'y'dx'}{(y'^2-x'^2)dx'-2x'y'dy'}\left(x-\dfrac{k^2x'}{x'^2+y'^2}\right)$.

Also solved by *G. B. M. ZERR.*

PROBLEMS.

30. Proposed by E. W. NICHOLS, Professor of Mathematics in the Virginia Military Institute, Lexington, Virginia.

Given the cardioid $r=a\ (1-\cos\theta)$; find the area of its circumscribing square formed by tangents making angles of 45° with its axis.

31. Proposed by E. B. ESCOTT, Ann Arbor, Michigan.

Through a point O on the produced diameter AB of a simicircle draw a secant ORR', so that the quadrilateral $ABRR'$ inscribed in the semicircle shall be a maximum. Prove that in this case, the projection of RR' on AB is equal in length to the radius of the circle. [*Williamson's Diff. Calculus, 7th edition, p. 189, Ex, 25.*]

MECHANICS.

Conducted by B. F. FINKEL, Kidder, Mo. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

12. Proposed by Professor J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

A horizontal table without weight is supported on three points A, B, and C. A weight W is laid upon the table, at a point G. If $AG=a$, $BG=b$, $CG=c$, $\angle AGB=\beta$, and $\angle AGC=\nu$, find the pressures upon A, B, and C.

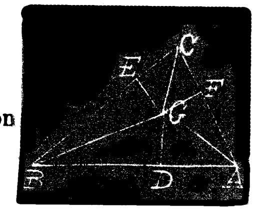
I. Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland, and L. B. FRAKER, Weston, Ohio.

From the problem, we have $AB=\sqrt{(a^2+b^2-2ab\cos\beta)},=m$. Simi-

larly $AC=n$, and $CB=p$. Put $\angle AGD=\phi$, $\angle CGF=\psi$, and $\angle BGE=\omega$; then, obviously, $a\sin\phi+b\sin(\beta-\phi)=m\ldots.(1)$,

$c\sin\psi+a\sin(\nu-\psi)=n\ldots.(2)$,

and $b\sin\omega+c\sin[2\pi-(\beta+\nu-\omega)]=p\ldots.(3)$.



Knowing the values of ϕ, ψ, and ω, from (1), (2), and (3), respectively, we obtain for the presures upon A, B, and C.

$\mathbf{P}_A=a[\sin\phi+\sin(\nu-\psi)]\,W\ldots.(4)$,

$\mathbf{P}_B=b[\sin\omega+\sin(\beta-\phi)]\,W\ldots.(5)$,

and $\mathbf{P}_C=c[\sin\psi-\sin(\beta+\nu-\omega)]\,W\ldots.(6)$.

II. Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi, University P. O., Mississippi, A. H. BELL, Hillsboro, Illinois; and the PROPOSER.

Let the pressures at A, B, and C be represented by these letters.

Taking moments about AG, $b\sin\beta.B=c\sin\gamma.C$.

Taking moments about CG, $a\sin\gamma.A=-b\sin(\beta+\gamma)B$.

Also, $A+B+C=W$. From these,

$$B=\frac{\sin\gamma}{b}W\div\left(\frac{-\sin(\beta+\gamma)}{a}+\frac{\sin\gamma}{b}+\frac{\sin\beta}{c}\right).$$

Denoting the quantity in the parenthesis by K, we have, from considerations of symmetry, $A=\dfrac{-\sin(\beta+\gamma)}{aK}W$, $C=\dfrac{\sin\beta}{cK}W$.

Excellent solutions to this problem were received from *G. B. M. ZERR*, and *P. H. PHILBRICK*

13. Proposed by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

A man, horse and buggy are going around a circular race course at a 2:40 gait. If the whole outfit weighs 1500 lbs, radius of course is 500 feet and track is inclined so that pressure is equal upon the wheels, find the pressure on the ground due to whole weight.

Solution by the PROPOSER.

In the figure, let C, the bob of the conical pendulum, represent the whole weight of man, horse and buggy$=M$. Let r=radius of curve, V= velocity per second, f=centrifugal force. Then $CG=m$, $CE=f$. Resolve CG into its components CH perpendicular to, and CL parallel to AC; also, CE into its components $CD=CH$ perpendicular to, and CK parallel to AC.

Then pressure$=P=m\cos\theta+f\sin\theta$, where $\theta=OAC$.

But $f=\dfrac{mv^2}{gr}$, and $v^2=\dfrac{gr^2}{h}$, where $h=AO$, $r=OC$.

$$\sin\theta=\frac{r}{\sqrt{(r^2+h^2)}},\ \cos\theta=\frac{h}{\sqrt{(r^2+h^2)}}.\quad\therefore\quad P=\frac{m\sqrt{(r^2+h^2)}}{h}.$$

Now let abc be a section of the road bed; then abc is similar to OAC, $ab=a$, $bc=e$, $ac=w$. Then $\dfrac{\sqrt{(r^2+h^2)}}{h}=\dfrac{a}{w}=\dfrac{a}{a\cos\theta}$. From the triangle